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AUTHOR(S):

Nishikawa, Mari

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Cohesion and behavioral synchrony among females in a wild group of Japanese macaques

Mari Nishikawa

Introduction

Group-living among animals is a common strategy used to avoid predators and overcome inter-group competition. However, individuals may incur costs due to intra-group feeding competition. Individuals living in a group appear to adjust spatio-temporal cohesion and behavior depending on the trade-offs between costs and benefits. In a social group with stable membership that is characterized by dominance hierarchy and kinship, individuals have to regulate their own spatial position and behavior depending on both ecological and social situations, resulting in characteristic grouping dynamics of each species and population. However, quantitative studies on spatio-temporal cohesion and behavioral adjustment are limited and have not been successfully integrated as one. To capture patterns of variation in these, including over larger spatial scales, simultaneous follow of individuals in a group must be done. This enables us to quantify synchrony (i.e., adjustment) in activities and travel directions among individuals. In the current study, I quantified the interindividual distance (IID) as an indicator of cohesion and behavioral synchrony among adult females in a group of wild Japanese macaques by simultaneous follows using GPS devices. The current study aimed to clarify grouping dynamics in terms of variation in IID, number/composition of individuals within visual range, separation duration beyond visual range, and synchrony of activity and travel direction.

Materials and Methods

The current study was conducted on Yakushima Island, Japan where Japanese macaques live in female-bonded social groups and have no natural predators. Visual range in the study area is ca. 20 m. Audible range of coo calls emitted during calm situations and loud vocalizations of macaques is ca. 100 m and 200 m, respectively. I studied the E group, which contained 38 individuals. Six females, three from high- and low-rank classes each, were chosen as subjects. In each dominance rank class, two of the three females were kin related. My collaborator and I simultaneously followed a different adult female using focal animal sampling, and we recorded the activity and the number of group members within sight of each focal female. I analyzed the relationship between IIDs and activity, dominance rank pair, and kinship. I defined a visual unit as all visible individuals within sight of each focal female. Separation duration was defined as the time period for which the focal females were located farther than 20 m apart from each other. I calculated the degree of synchrony of overall activity and each activity using Cohen's *k*. Generalized linear mixed models were used to quantify factors affecting spatio-temporal cohesion, synchrony of activities, and travel direction among females.

Results

I found considerable variation in spatio-temporal cohesion among females. The overall median IID was 47.4 m (range = 0–618.2 m). Generally, female pairs were located beyond visual range but within audible range of loud vocalization for over half the observation time. IIDs varied with activity, being shorter during grooming and resting and longer during foraging and traveling. Low-ranking females displayed less cohesion. Kin females generally remained within audible range of coo calls, and rarely ventured beyond audible range of loud vocalizations. The macaques exhibited low cohesion with a small mean visual unit size. The visual units composed of adults of both sex (including juveniles) were the most frequently observed unit type when they were grooming or resting. Conversely, the units composed of adult females were the most frequently observed when they were foraging. The overall median visual separation duration was 10 min (range = 3–513 min). Separation duration was the shortest between high-ranking females.

The degree of overall synchrony of activity was positive compared with the expected value. Although, the overall degree value was not high (Cohen's k = 0.13), it was highest when paired macaques were located within visual range. The factors which affected synchrony were different across behavioral categories. IID affected synchrony during grooming and resting; the degree of synchrony was highest when paired females were located within visual range. In addition, synchrony varied depending on the dominance rank of paired females during foraging and grooming; high-ranking pairs exhibited the highest synchrony. Kinship also affected traveling synchrony, with kin females displaying higher traveling synchrony. The frequency of synchronous travel direction was similar within 100 m, but sharply declined beyond this distance. High-ranking paired females displayed the highest synchrony of travel direction.

Discussion

The longer IIDs observed when paired females engaged in foraging and traveling suggest that females decreased spatial cohesion to avoid intra-group competition for food, with low-ranking females delaying the timing of foraging. These results suggest that a predator-free environment permits low-ranking females to exist in low cohesion and flexible behavior to avoid intra-group competition. Higher cohesion during grooming and resting suggests that these activities contribute to maintaining affiliation between group members. The dispersion beyond 100 m mainly occurred between non-kin pairs, and the degree of travel direction and activity became lower, suggesting sub-grouping. Higher spatio-temporal cohesion and behavioral synchrony among high-ranking females may be explained as a countermeasure against encountering neighboring groups.